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ABSTRACT

Designed to develop creativity in young learners, this book contains interdisciplinary activities which focus on the theme of light and color. Activity pages are provided that can serve as front and back covers of a student booklet and the suggested activities can be duplicated for insertion between the covers resulting in a booklet for each student. A teacher/parent guide is included and supplies background information, activity descriptions, materials needed, and possible answers for the activities. A variety of exercises are provided on such topics as: (1) refraction; (2) light reflection; (3) eyes and vision; (4) vision problems; (5) color and emotion; (6) holography; and (7) primary colors. (ML)

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GOOD APPLE

YOUNG SCIENTISTS EXPLORE

Light & Color

BOOK 12 INTERMEDIATE LEVEL

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YOUNG SCIENTISTS EXPLORE

LIGHT & COLOR

Book 12 — Intermediate Level

By **Jerry DeBruin**

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PREFACE
A NOTE TO TEACHERS AND PARENTS

Dear Friends,

Thank you for the many kind comments about my previous books, *Creative, Hands-On Science Experiences* (CHOSE) published by Good Apple, Inc., in 1980 and the first nine books in the *Young Scientists Explore* series published by Good Apple, Inc., in 1982, 1983 and 1985.

This book, *Young Scientists Explore Light & Color* is written as a result of your comments and suggestions, comments that suggested a need for handy science books that contain activity sheets which could be duplicated for students' use. *Young Scientists Explore Light & Color* is an attempt to meet this need.

Young Scientists Explore Light & Color is the twelfth in a series of books that features science activity sheets which provide youngsters with a variety of interesting and challenging science-related experiences using experiments, puzzles, cutouts, charts, and seek-a-words. Youngsters are encouraged to gain firsthand experience while doing the activities, for it is through firsthand experience that meaningful learning occurs. Emphasis throughout the book is placed on the development of creativity in the learner. It is hoped that this creativity will be nurtured both during and after the activities are done.

You, as teachers and parents, are encouraged to make duplicating masters, copies and transparencies from the pages found in *Young Scientists Explore Light & Color*. The activities, following a day in the life of a child, are interdisciplinary and nonsequential in nature and are meant to integrate and extend existing science instruction with other academic areas. To achieve this purpose, the book contains an interdisciplinary grid, possible answers and a student book. When completed and mounted on single-layered cardboard and bound with tape, activity sheets 2 and 3 make up both the front and back covers of the Student Booklet. Completed student activity sheets can then be inserted between these covers and placed in a three-ring binder or file folder with the result being a permanent booklet for each youngster to take home for the entire family to enjoy.

My hope is that these activity sheets will touch many minds, hearts and hands and that much personal growth will be experienced by all who do the activities. Keep in touch. Let me know how you are doing. It is always good to hear from you. Until then, best wishes in your continued growth as a scientist and as a complete human being.

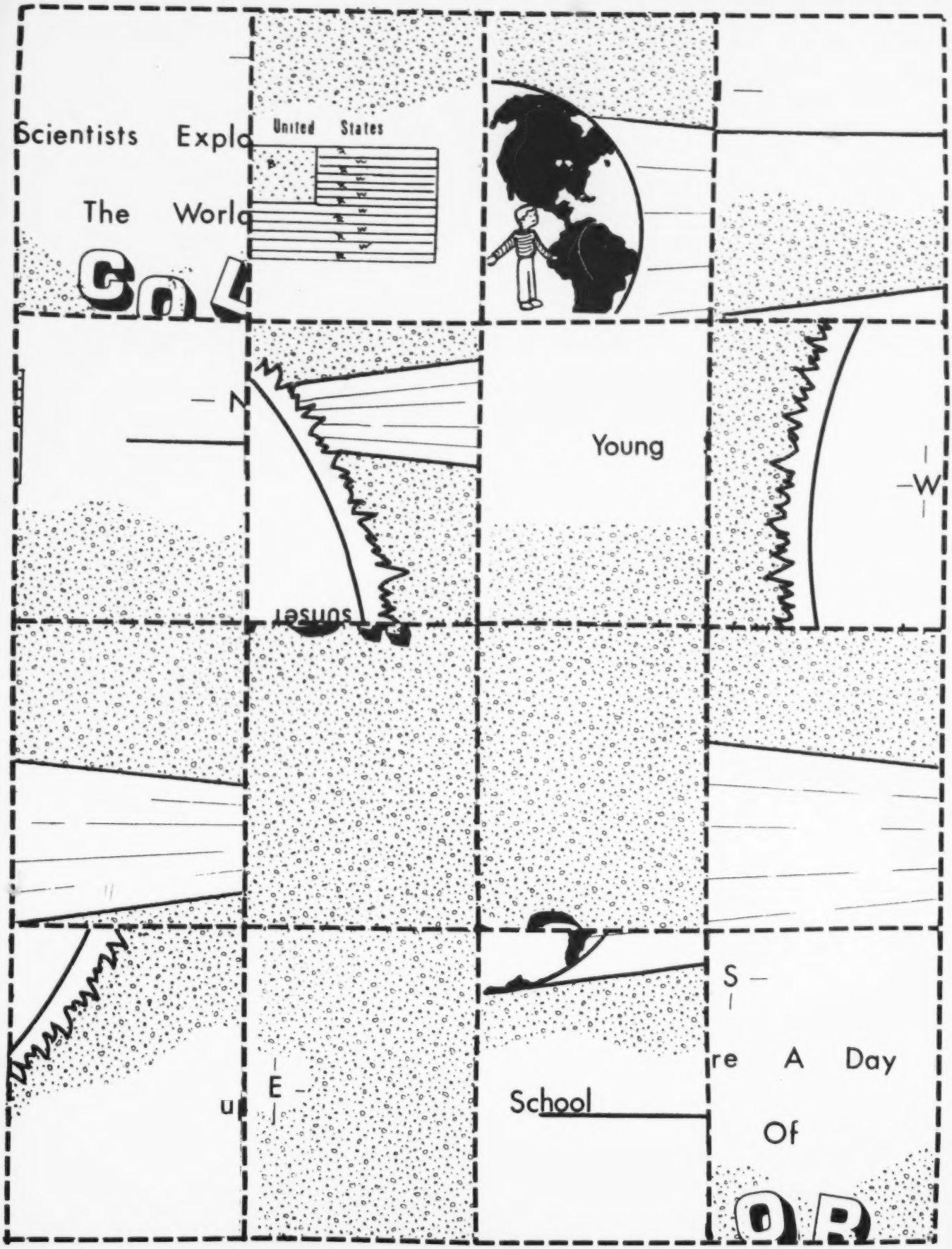
Sincerely,

Jerry DeBruin

Jerry DeBruin

Note: Flags of various countries appear in the upper right corners of the pages. Have youngsters color each flag by following this code: Yellow (Y), Blue (B), White (W), Red (R), Green (G), Black (BK) and Purple (P). Each flag has a feature that is related in some way to the activity. (See page 32 and inside back cover for possible relationships.) Discuss what each feature means. When pages are completed, bend back corners with thumb and forefinger. Release corners; the result is a flip book of world flags for each youngster.

Name
Young
Scientists Exp
sunrise
In The
Japan


Scientists Explo
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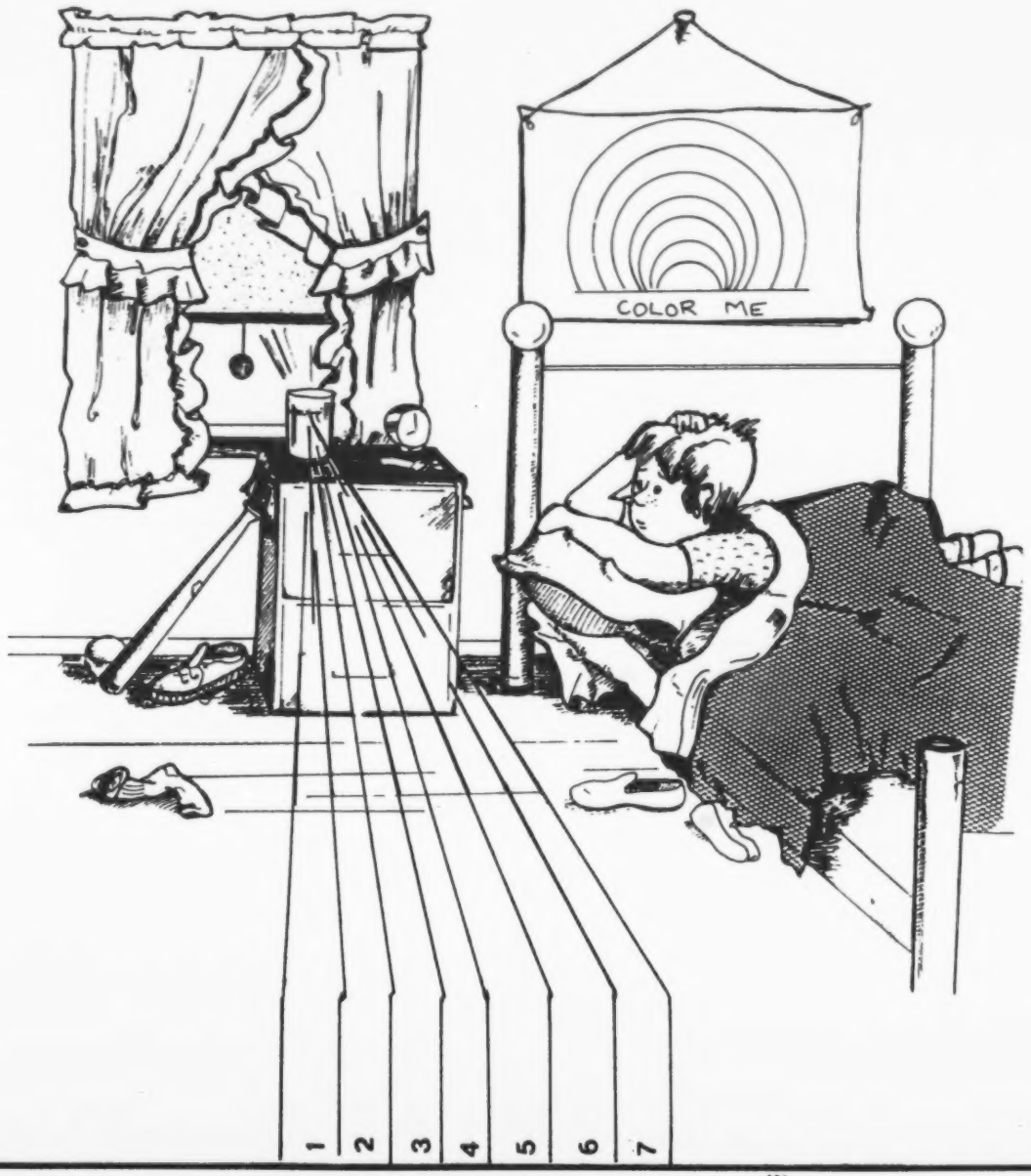
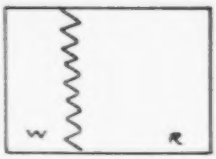
OR

GOOD MORNING SUN: MEET LICOL

The sun rises in the East as a new day begins for Licol, a curious youngster who likes to investigate things in the world. On this morning, Licol opens his eyes as the sun rises. For safety reasons, however, he does NOT look directly at the sun. Sunlight travels in straight lines observes Licol. It travels through window glass and a glass of water found near the bed. Licol observes seven colors coming from the glass. He names the colors ROY G. BIV, a short way to remember the colors of light. With a prism or a glass of water, set up the colors Licol sees below. Write the name of the color in the blank next to the number. Complete the sentence below. On the back of this page, make a list of objects that have your favorite color. Then write some sentences that tell about the color of these objects. EXAMPLE: The sun is yellow. Yellow are bananas. Lemons are yellow. Yellow is a daffodil. Yellow is the color I like best because _____.





BAHRAIN

A SPOONFUL OF BENDS

Knowing that light travels in straight lines, Licol jumps out of bed. He is hungry. At the breakfast table, Licol observes that there is something wrong with the spoon found in a glass filled with clear juice. Help Licol find out what's wrong. Half fill a glass with water as shown in Figure B. Put a spoon into the glass. Hold the glass at eye level. Look closely at the spoon. Compare to spoon in empty glass in Figure A. In glass B below, draw what your spoon appears to look like, especially where air meets the water and spoon. Why does the spoon appear to look this way? Answer this question by finding the word *refraction* on this page. Then write the definition for the word *refraction* in the blanks.

Figure A

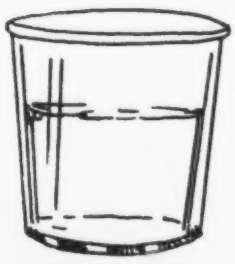


Figure B

_____

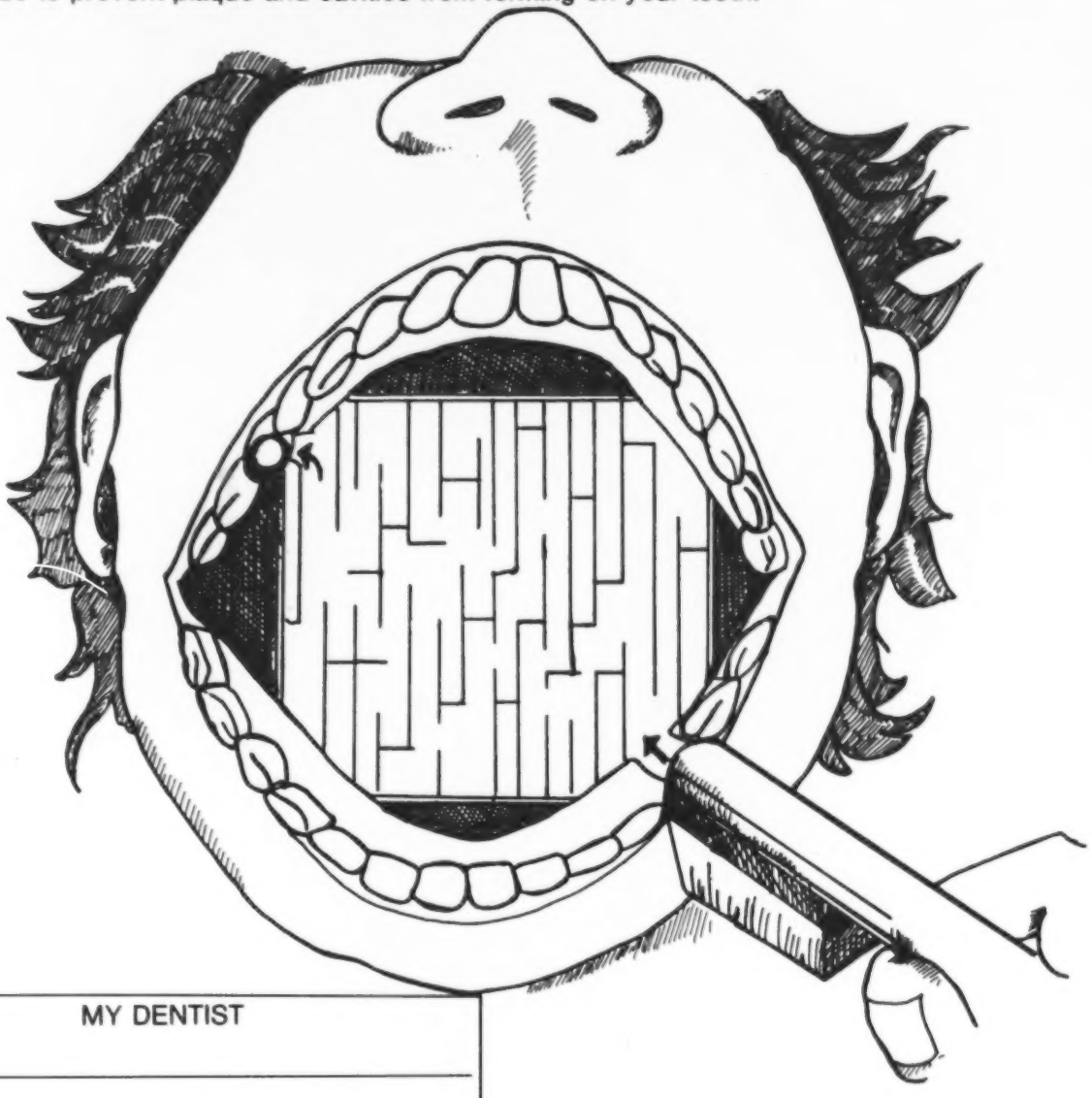
_____

_____

_____

TOOTHBRUSH TRAVELS

Licol now knows that light can be bent or **refracted**. After a hearty breakfast, he goes to the bathroom to wash up and brush his teeth. He puts his toothbrush into a glass half-filled with water to check his previous learning. "Sure enough, the toothbrush, like the spoon at breakfast, also bends," says Licol. Looking into the mirror, Licol notices his pink gums and white teeth. While brushing his teeth, however, Licol observes a small black spot on one tooth. In the maze below, help Licol discover the black spot. Then unscramble the letters below. Write the name of the black spot in the blank. Color this spot on the tooth black, the gums pink. In the chart below, fill in the name, address and phone number of your dentist. On the back of this page, design a poster that gives tips on what you could do to prevent plaque and cavities from forming on your teeth.



MY DENTIST

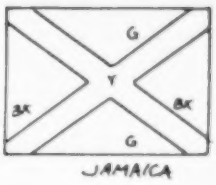
NAME _____

ADDRESS _____

PHONE NUMBER _____

DATE LAST VISITED _____

AVTYIC _____



MIRROR MAGIC

From his activity at breakfast, Licol discovered that light can be bent or **refracted**. After brushing his teeth, Licol looks into the bathroom mirror. He sees himself because light bounces off the mirror and back into his eyes. This is called **reflection**. However, something is wrong as Licol sees his whole body crossed over. Everything seems to be just the opposite. Below are two pictures of Licol. In Picture A, you see Licol from the back as he looks into the mirror. In Picture B, you see Licol looking outward from the mirror. Circle the correct answers below.

Licol looks like this from the back. Answer the questions as you stand behind Licol.

Picture A

1. The hairbrush is in Licol's (left, right) hand.

2. The glass of water is in Licol's (left, right) hand.

3. The part in Licol's hair is on the (left, right) side.

BONUS QUESTION: If Licol had a freckle on the **right** side of his face,

THEN

to you, Licol would have a freckle on the (right, left) side of his face.

Licol looks like this in the mirror. Answer the questions below as you look into the mirror at Licol.

Picture B

1. As you look into the mirror, Licol now holds the brush in his (right, left) hand.

2. As you look into the mirror, Licol now holds the glass of water in his (right, left) hand.

3. As you look into the mirror, the part in Licol's hair is now on the (right, left) side.

Now, try Licol's experiment on yourself. On the back of this page, draw a picture of a freckle on the **right** side of your face. Using a mirror, move the freckle to the left side of your face. Why does this happen? Find out by studying further how a mirror is made and how it works.

BK
W
R

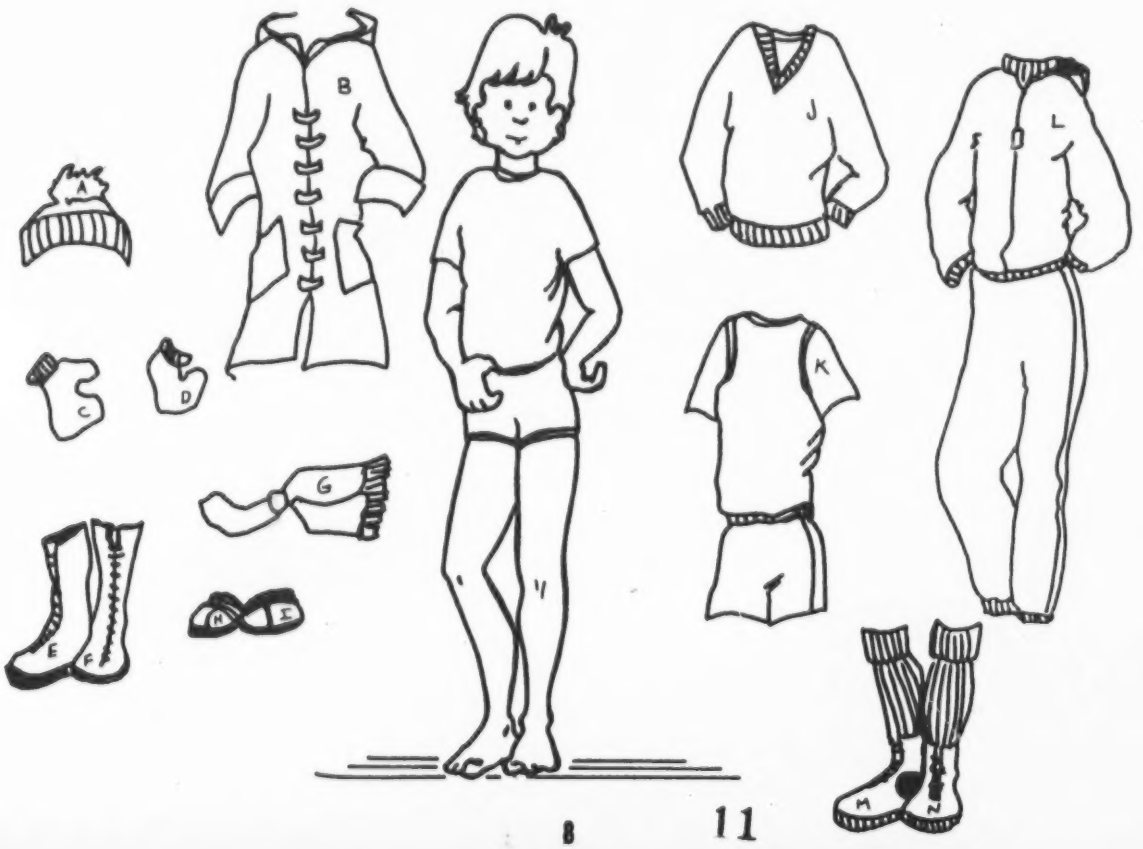
UPPER VOLTA

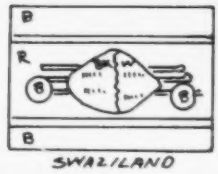
DRESS FOR SCHOOL

Licol now begins to dress for school, but he is not sure of what clothes to wear. His parents tell him that it will be a hot, dry day with no rain in sight. Do the experiment below to help Licol decide on what clothes to wear.

BLACK WHITE DARK BLUE YELLOW

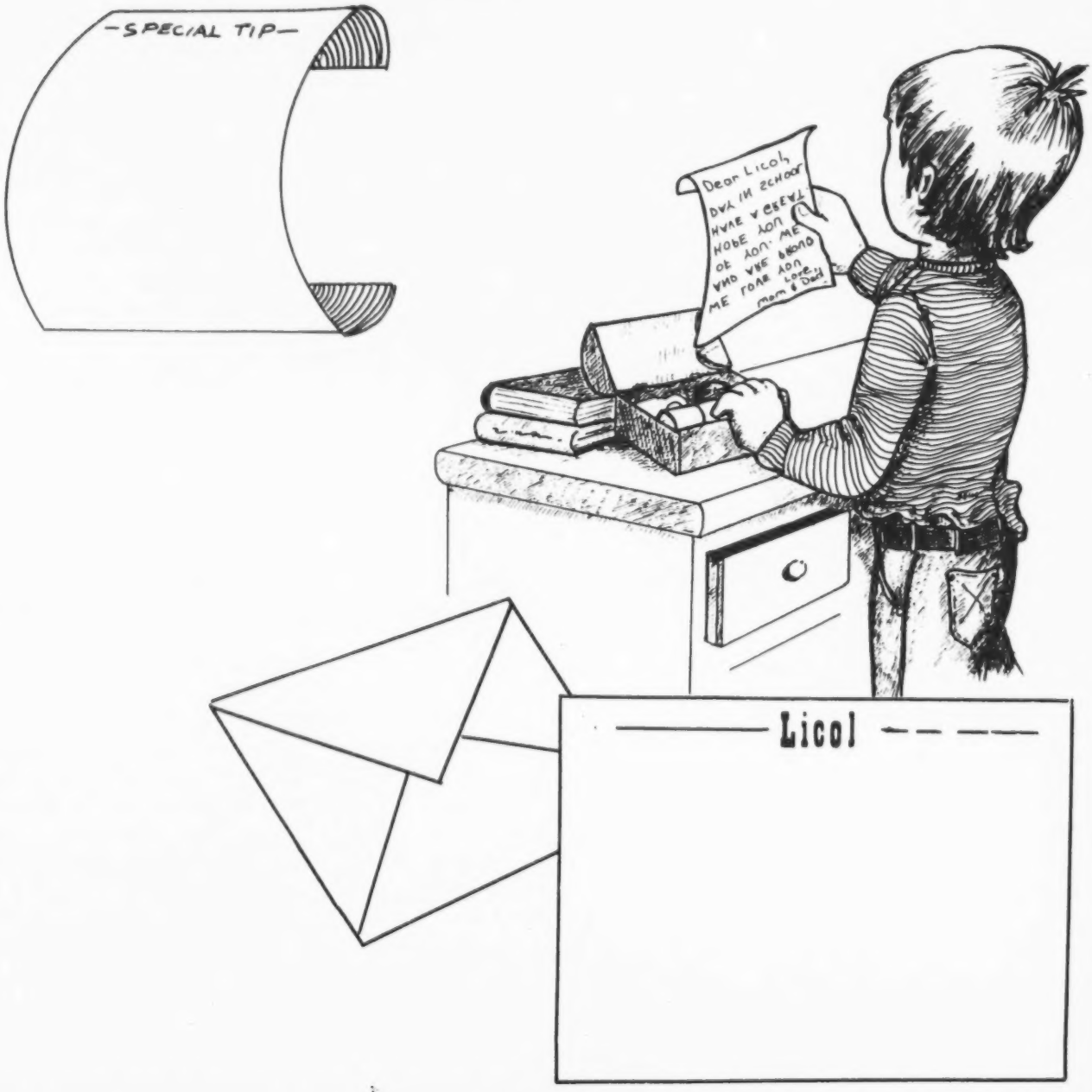
Directions: Cut out and glue matching pieces of colored paper to the above squares. Move paper into sun or place under a lamp. Place the same size (small) ice cubes on top of each square. Time how long it takes for each ice cube to melt. Which color keeps the ice cube from melting the longest? _____ Using the results from this experiment, draw a line from the clothes that Licol should wear on this day to the correct part of his body. Color these and other warm weather clothes a light color, cold weather clothes a dark color. On the back of this page, write a note to Licol that tells him why he should wear these colored clothes. Then complete these phrases for Licol: As black as . . . As white as . . . As blue as . . . As yellow as . . .

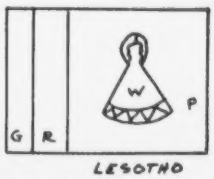




SECRET MESSAGE

It was while eating breakfast that Licol discovered how light could be bent or **refracted**. In the bathroom, he saw his reversed image being made by light waves that bounced off a mirror. This is called **reflection**. After Licol dressed for school, he opened his lunch box and noticed a secret message written to him by his parents. It looked strange because it, too, looked reversed. Using a mirror, help Licol decode the message. Write the decoded message in your science notebook. Then on Licol's stationery below, use a mirror and pencil to write a return message to your parents. Have them decode your message by using a mirror. Then write a secret message to one of your friends.

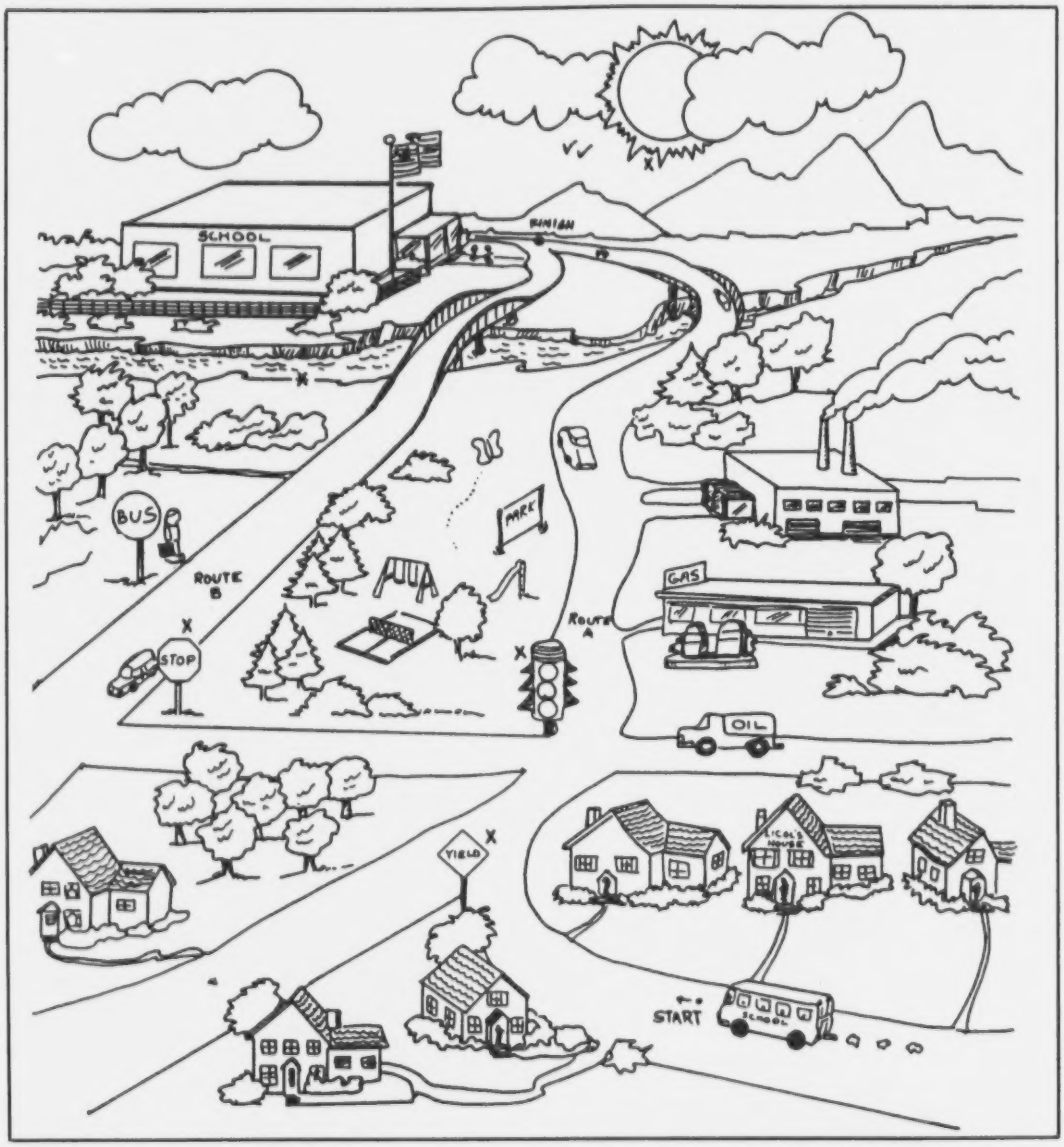




LESOTHO

OFF TO SCHOOL

After Licol writes a secret message to his parents, he picks up his lunch box and school bag and boards the school bus. He observes that the sun has risen higher in the sky. He notices that it's much brighter and more colorful than just a short time ago. The picture below shows two routes that Licol takes to school. Help Licol find the **shortest** route. Place a length of string on each route. With a ruler, measure the length of each string in inches (cm). Record below. Which route is the longest? _____ Shortest? _____ Read the scale below. Figure the distance for each route in miles (kilometers). Record these distances in the blanks below. Then pretend you are riding to school with Licol. Color the objects marked with an "x" the correct color: stoplight, stop sign, yield sign, sun, and water in the stream.

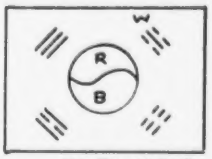


Route A = _____ inches
Route B = _____ inches
Scale: 1 inch = 2 miles
2 miles

Route A = _____ miles
Route B = _____miles

Route A = _____ centimeters
Route B = _____ centimeters
Scale: 1 cm = 2 kilometers
2 kilometers

Route A = _____ kilometers
Route B = _____ kilometers



SOUTH KOREA

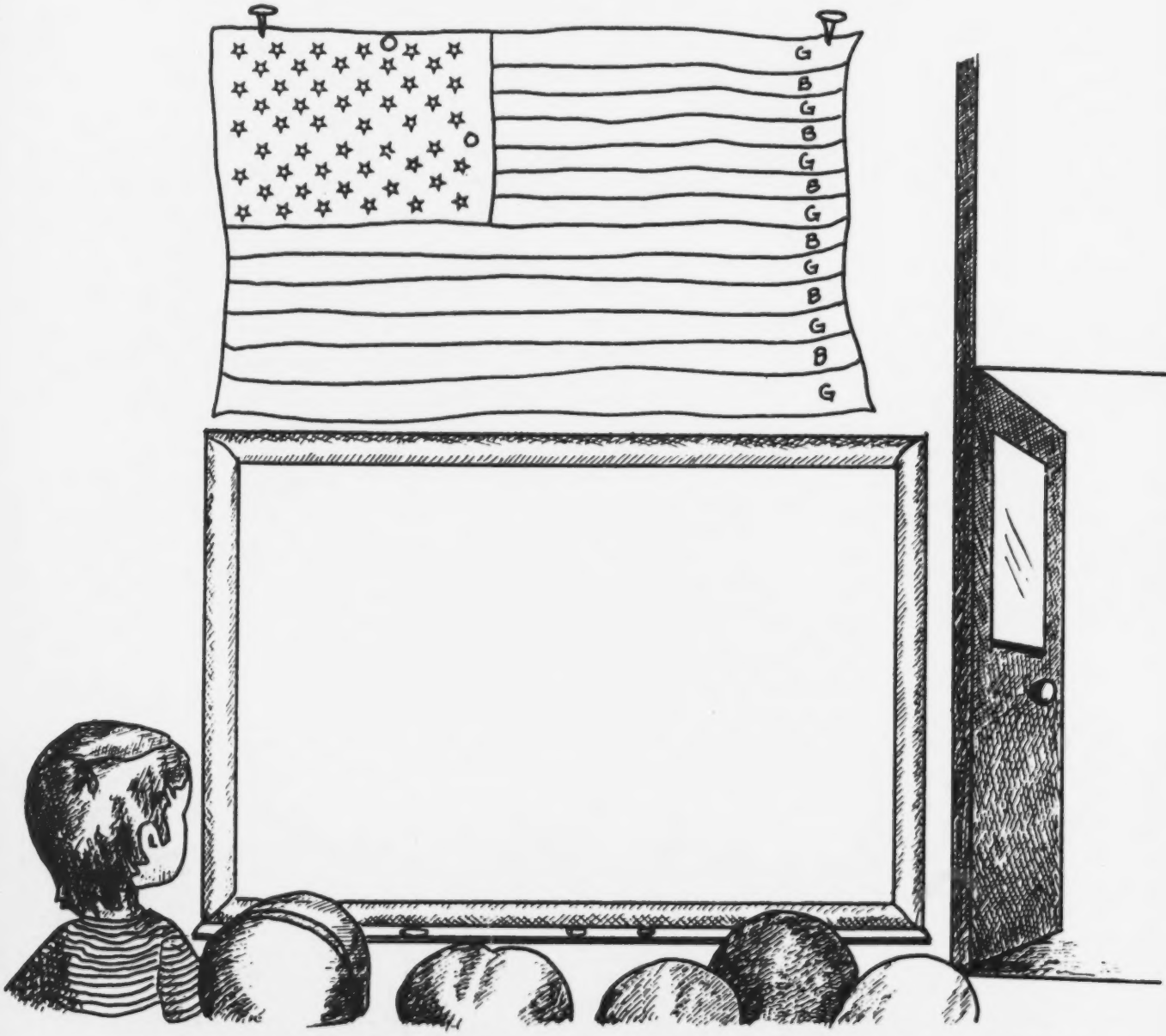
LICOL MEETS COLORFUL PEOPLE IN SCHOOL

Licol hops off the bus, walks into school and is greeted by many colorful people. He remembers these people by the colors of their eyes, hair, and the clothes they wear. You can do the same. Below are pictures of six important people in your school. Visit and name each one. Follow the directions below each picture to help you remember something colorful about each person.

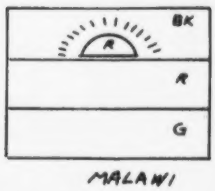
PRINCIPAL	SECRETARY	CUSTODIAN
Name_____ Favorite Color: _____	Name_____ Wears glasses: Yes No	Name_____ Number of Steps: _____
Visit the principal. In the space above, draw and color the principal's clothing. Find out the principal's favorite color and why.	Meet the secretary. Color the iris in the secretary's eyes above. Find out if the secretary wears glasses.	Visit the custodian. Color the custodian's shoes above. Find out how many steps the custodian makes to turn on the school lights.
FOOD SERVICE WORKER	**NURSE**	**LIBRARIAN**
Name_____ Color in food: _____	Name_____ First letter on eye chart: _____	Name_____ Title of best light and color book: _____
Visit the kitchen. Color a food service worker's hair above. Find out how color is used in foods.	Meet the nurse. Color the nurse's uniform above. Ask the nurse to show you the Snellen eye chart.	Visit the librarian. Write the name of the librarian's favorite book above. Ask for books on light and color.

LICOL MEETS HIS TEACHER

Licol walks into the classroom and meets his teacher. He notices that his teacher is lighthearted and the classroom is warm and colorful. Together, they begin the school day by saying the Pledge of Allegiance. In Licol's classroom below is a picture of the U.S. flag. Color the "O" areas orange, "G" green and "B" black. Stare at the flag for 45 seconds. Shift your eyes to the white space below the flag. Draw and color a picture of what you see. Then try other flags found in this book. What colors must the flags be to bring out the true colors in the flag? Investigate how the **cones** in your eyes help you see colors. Write your findings on the back of this page.



PLEDGE OF ALLEGIANCE: I pledge allegiance to the flag of the United States of America and to the Republic for which it stands, one Nation under God, indivisible, with liberty and justice for all. Written by Francis B _ _ _ _ _ _ _.



LICOL DOES AN EYE OPENER ACTIVITY

After the Pledge of Allegiance, Licol and his friends share their feelings during eye opener activity. Looking into each other's eyes, they ask questions about how the eye works. Below is a picture of the eye. Using an encyclopedia and the words below, write the names of the correct eye parts in the blanks in Figure A. In Exercise B, write the letter of the correct sentence that tells what that part does in the blank next to the name of the eye part. Then write the beginning of a story of something that happened to you that was a real eye opener. Have a friend write an ending to the story. Read the story before going on your looking walk in Exercise C.

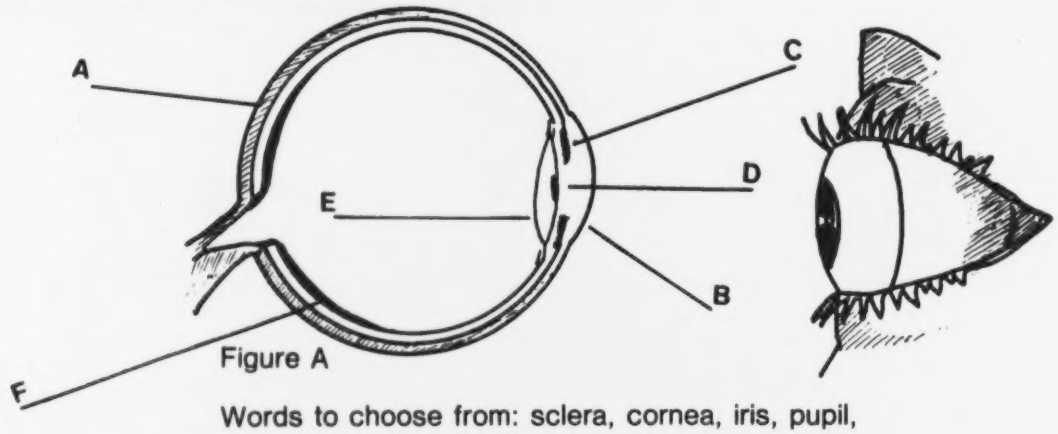


Figure A

Words to choose from: sclera, cornea, iris, pupil, lens, retina

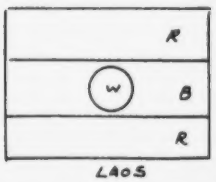
Exercise B:

Eye Part	Description
_____ 1. cornea	A. I am the tough, white protective covering of the eye.
_____ 2. sclera	B. I am the transparent bulging front of the eye through which light passes.
_____ 3. pupil	C. I am colorful and control the size of the pupil. Some people call me "blue eyes."
_____ 4. iris	D. I am the round black hole in the center of the iris. I let in more or less light.
_____ 5. lens	E. I reside behind the pupil and focus light on the retina.
_____ 6. retina	F. I am a thin sensitive sheet of nerve fibers behind the eye. I am sensitive to light and send signals to the brain.

Exercise C:

With your teacher or parents, take a looking walk around your home or school. Make a list of all the things you see. Write a color and size word for each thing.

Example: My eyes saw a little rust brown squirrel.



PUPIL POWER

After Licol observes his friend's eyes during eye opener time, he uses a small mirror to observe his own pupil size. He finds out quickly that his pupils are quite small when in normal light (Figure A) and large when he is in, or leaves, a dark room or shadow (Figure B). Repeat Licol's experiment. Using a mirror, observe your pupils when in normal light and while in or leaving a dark room or shadow. Draw a picture that shows the size of your pupils in Figures C and D below. Find out what part of the eye controls the size of the pupils. Write its name in the blanks below. In Figures C and D, color the color of your eyes. Draw and color the rest of your face. Show your picture to the class. Then tell your friends something special about yourself at the next eye opener activity.

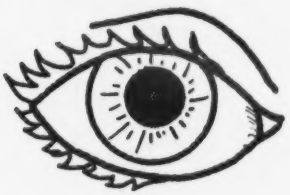


Figure A
Licol's pupil size in normal light

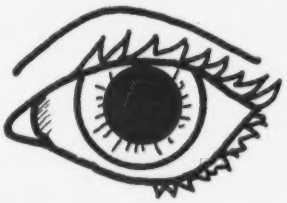


Figure B
Licol's pupil size after being in dark or shadow

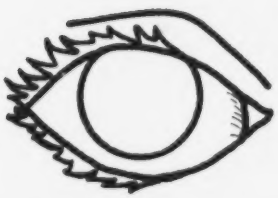


Figure C
My pupil size in normal light is _____.

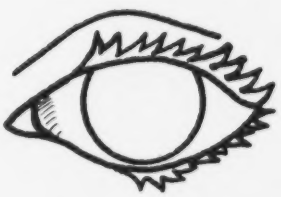
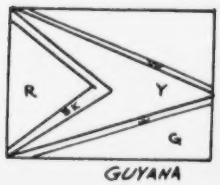


Figure D
My pupil size after being in dark room or shadow is _____.

The i _ _ _ controls the size of the pupils in your eyes.

17



GET THE ANGLE

After Licol opens his eyes wide in the eye opener activity, he begins to study angles in mathematics class. He learns that an angle is the space between two lines that come to a point. Light waves form angles too. Licol recalls that light, when bent, is called **refraction**, and when it bounces off things it is called **reflection**. When light reflects off a mirror, two angles are created—the **angle of incidence** (incoming light) and the **angle of reflection** (outgoing light). These two angles are nearly equal. Below are two pictures, one of a large angle (Figure A), the other a small angle (Figure B). Connect the dots to make the angles of **incidence** and **reflection** in each figure. With a protractor, measure the number of degrees in both the **angle of incidence** and **angle of reflection** for each angle. Write your answers in the boxes. Then help Licol find out if the angles in Figures A and B and in the flag above are "obtuse" or "acute."

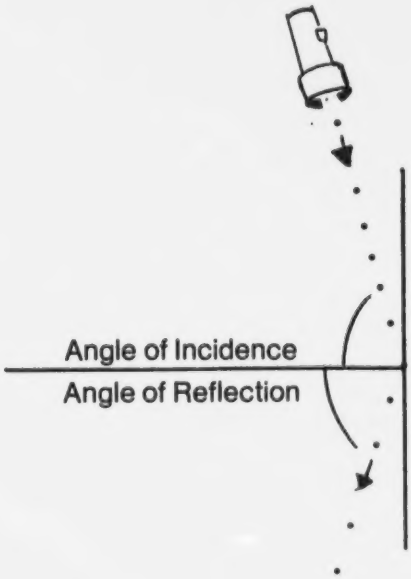


Figure A: Large Angle

Number of degrees in angle of incidence = ☐
Number of degrees in angle of reflection = ☐

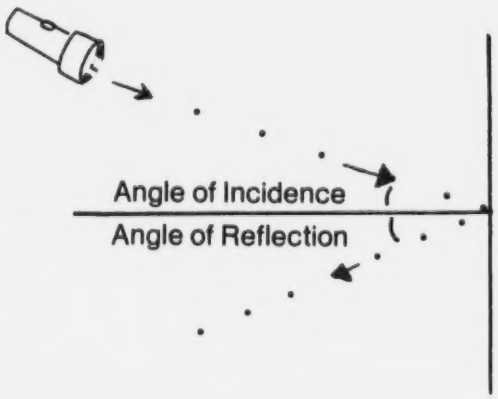
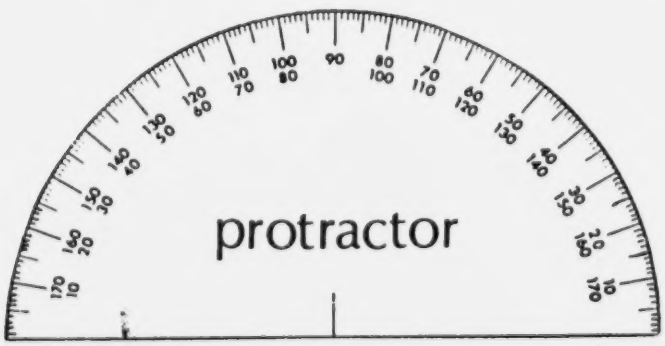
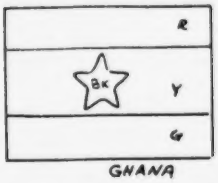


Figure B: Small Angle

Number of degrees in angle of incidence = ☐
Number of degrees in angle of reflection = ☐





READING BLINDNESS

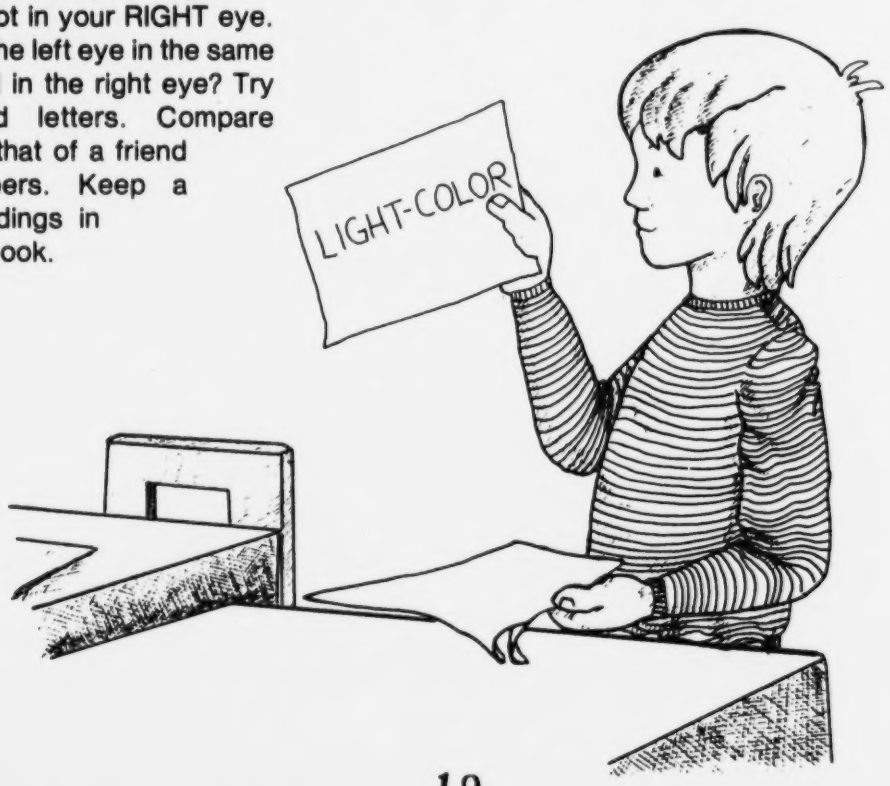
After mathematics class, Licol goes to reading class and does the following experiment. He reads the words *light* and *color* carefully and soon discovers that his name came from two words, LI from **li**ght and COL from **col**or. While experimenting, Licol discovers a way to leave out some of the letters in his name. You can do the same. Hold this page about 12" (30 cm) from your eyes. Close your right eye. Starting at the light bulb, slowly read the letters that make up Licol's name in Figure A. Did you notice that the light bulb disappeared when you read some of the letters? Circle the letter(s) in Figure A.

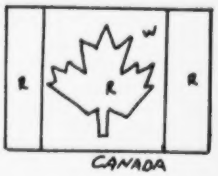
L I G H T — C O L O R Figure A

The part where you cannot see the light bulb is called the **blind spot**. This is a small area inside each eye where you cannot see anything. The letter(s) where you cannot see anything is the blind spot in your LEFT eye. Don't worry though; everybody has a blind spot. It's perfectly normal.

R O L O C — T H G I L Figure B

Using Figure B, close your **left** eye. Read the letters backwards from the eyeball to the letter "R." At which letter(s) does the eyeball disappear this time? Were the letters the same as before? Circle the letter(s) in Figure B. This is the blind spot in your RIGHT eye. Is the blind spot in the left eye in the same place as that found in the right eye? Try other names and letters. Compare your blind spot to that of a friend and family members. Keep a record of your findings in your science notebook.

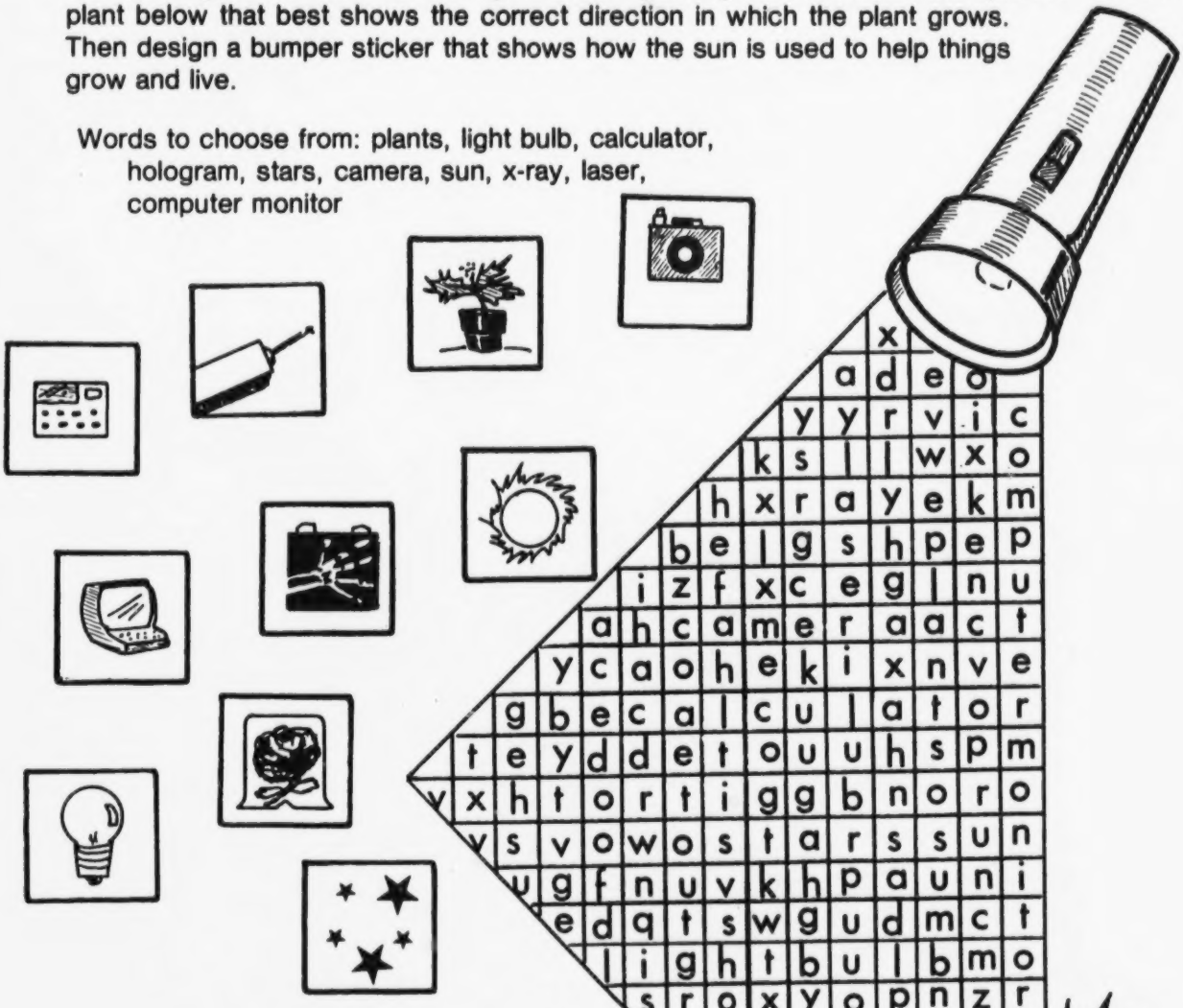




READING AWARENESS

With one eye closed, Licol found the blind spot in the open eye. He learned that the blind spot is an area inside each eye where one cannot see anything. Licol knows, however, that having a blind spot is perfectly normal and is nothing to worry about. With both eyes open, Licol does the language arts exercise below. Find and circle the words hidden in the puzzle that best describe the objects that use or give off light. For example, plants use light to grow. Pretend that you are a seed. Plant yourself in the ground. Act out your growth. How does light affect your growth? Circle the picture of the plant below that best shows the correct direction in which the plant grows. Then design a bumper sticker that shows how the sun is used to help things grow and live.

Words to choose from: plants, light bulb, calculator, hologram, stars, camera, sun, x-ray, laser, computer monitor


x
a d e o
y y r v i c
k s l l w x o
h x r a y e k m
b e l g s h p e p
i z f x c e g l n u
a h c a m e r a a c t
y c a o h e k i x n v e
g b e c a l c u l a t o r
t e y d d e t o u u h s p m
y x h t o r t i g g b n o r o
y s v o w o s t a r s s u n
u g f n u v k h p a u n i
e d q t s w g u d m c t
l i g h t b u l b m o
s r o x y o p n z r

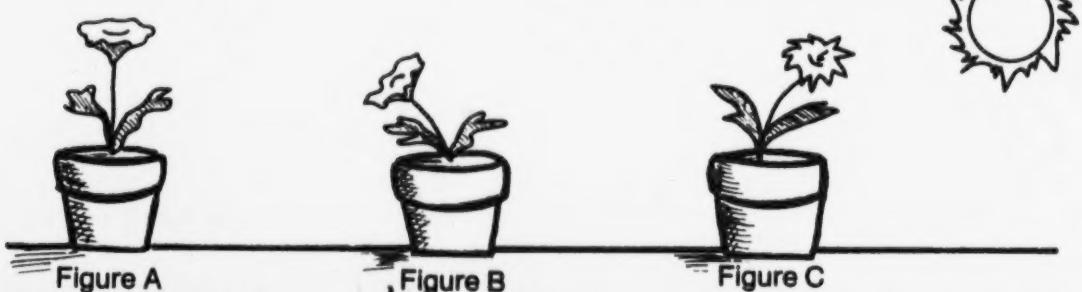
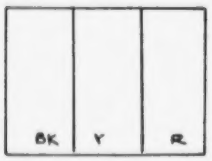


Figure A Figure B Figure C

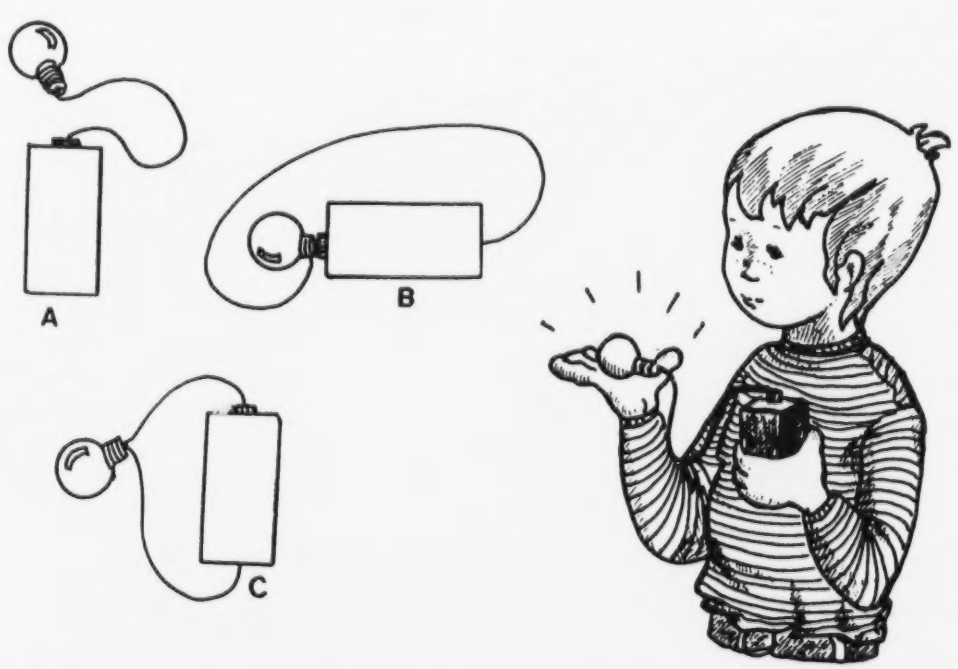


BELGIUM

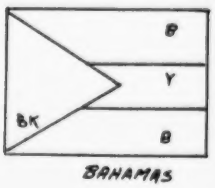
SPELL THEM RIGHT

Licol understands that many objects use or produce light. Sometimes, however, the lights go out and mistakes are made. This happens in spelling class. Help Licol correct the mistakes. Color the box **yellow** if the word is spelled correctly, **black** if spelled incorrectly. In the blank, spell the incorrect words correctly. Then, using one 1.5 volt dry cell, one wire and one flashlight bulb, try to light the bulb in ways shown below. On the other side of this page, draw a picture of all the ways that you tried to make the bulb light. Include ways that you could or could not light the bulb. Then pretend that all the lights in your home have gone out. It suddenly becomes very dark. When we cannot see in the dark, our ears can tell us many things. Using a tape recorder, record sounds heard in the night. Play back to the class. Be sure the classroom lights are off when you play your tape.

☐ 1. Silhouete_____
☐ 2. Shadow_____
☐ 3. Concave_____
☐ 4. Ilusion_____
☐ 5. Convex_____
☐ 6. Refract_____
☐ 7. Reflect_____
☐ 8. Agnel_____
☐ 9. Optics_____
☐ 10. Spectrum_____
☐ 11. Lenses_____
☐ 12. Miror_____
☐ 13. Image_____
☐ 14. Rainbow_____
☐ 15. Symetry_____
☐ 16. Incidance_____
☐ 17. Ray_____
☐ 18. Diffraction_____
☐ 19. Prism_____
☐ 20. Quantum_____
☐ 21. Filter_____



21



EYE CORRECTIONS

After spelling class, Licol is hungry and wants lunch now. As he enters the lunchroom he observes how some youngsters, like Todd and Jenny who corrected their spelling words, also wear eyeglasses to correct their vision. Opening his lunch box, Licol compares his metal spoon to Todd and Jenny's eyeglasses. Do what Licol does. Observe yourself in the caved in side of a metal spoon. It looks thin at the center. The light rays spread outward and your image is upside down and small. This is called **concave**. Turn the spoon over. Observe how the spoon curves outward, appears thicker at the center and how light waves meet closer to the center. Your image is right side up. Call this **convex**. Write the name of the lens (concave, convex) in the blanks in Figures A-D below. Then in boxes E and F draw the lens (concave, convex) that would correct Todd and Jenny's vision.

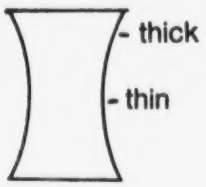


FIG. A

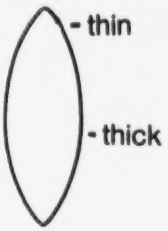


FIG. B

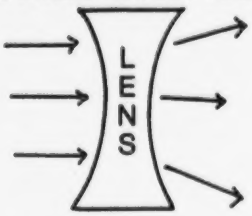


FIG. C

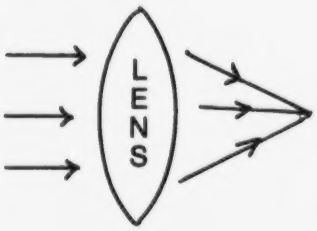


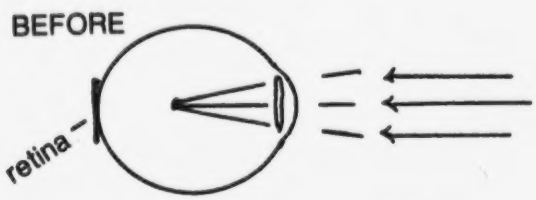
FIG. D

TODD IS NEARSIGHTED

- Trouble seeing things far away.
- Image in focus in front of retina.
- Long eyeball.

JENNY IS FARSIGHTED

- Trouble seeing close objects.
- Image in focus behind retina.
- Shorter eyeball.



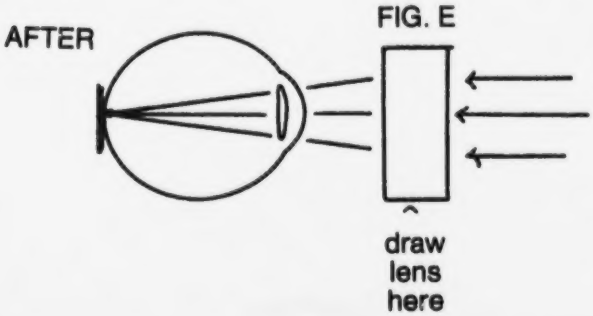
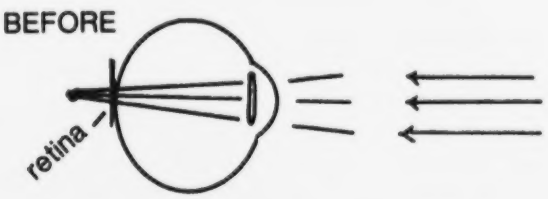


FIG. E



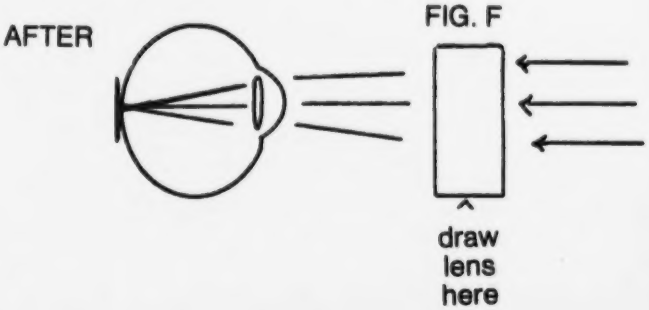
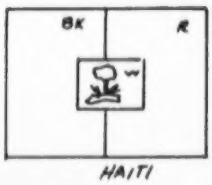


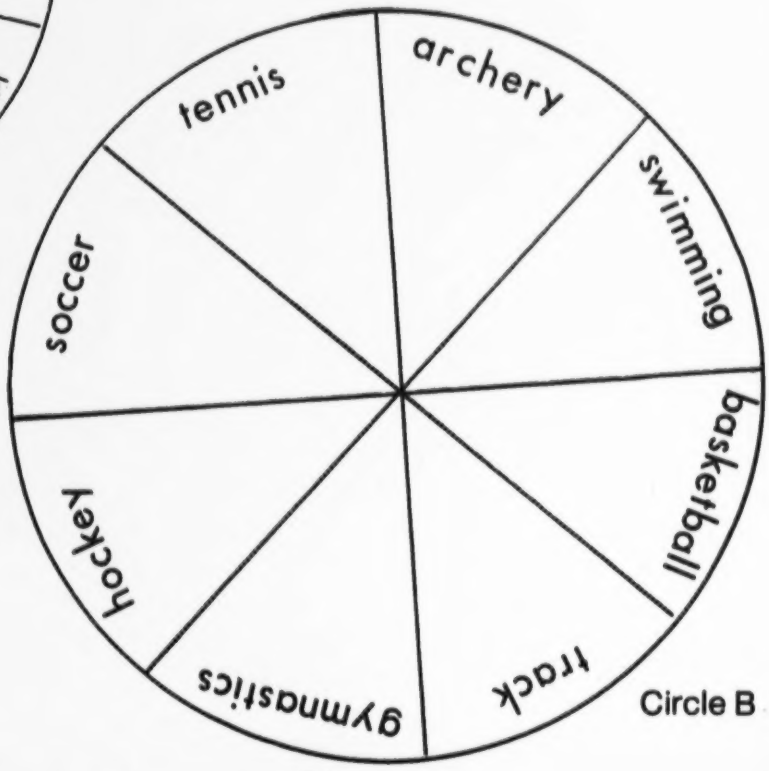
FIG. F



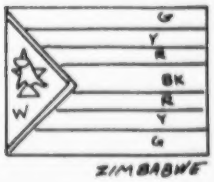
SHADOW TAG

After lunch, Licol goes out to play. He observes how the sun is nearly overhead at noon, but some shadows are still present. Licol looks closely at a friend whose body **blocks** out the sun and makes a shadow. They play shadow tag by stepping on each other's shadow. Make your own spinner shadow game below. Cut out Circles A, B and the pointer. Glue each to single-layered cardboard. Punch holes in centers of Circles A, B and pointer. Place pointer on top of Circle A and Circle A on B. Insert cardboard disc between circles to act as a washer. Attach at centers with paper fastener or straightened paper clip. Spin pointer. Read name of sport on Circle B. Rotate Circle A until the player's shadow matches the name of the sport. Make other shadow wheels that show how the sun blocks out light to make shadows. Observe time of day when shadows are long and short. Then measure the length of your shadow at 10:00 a.m., 12:00 noon, and 2:00 p.m. At what time of the day are shadows shortest? Longest? Find out how a sundial works. On a piece of paper, make a list of action words that tell what your shadow does in a shadow tag game.

Circle A

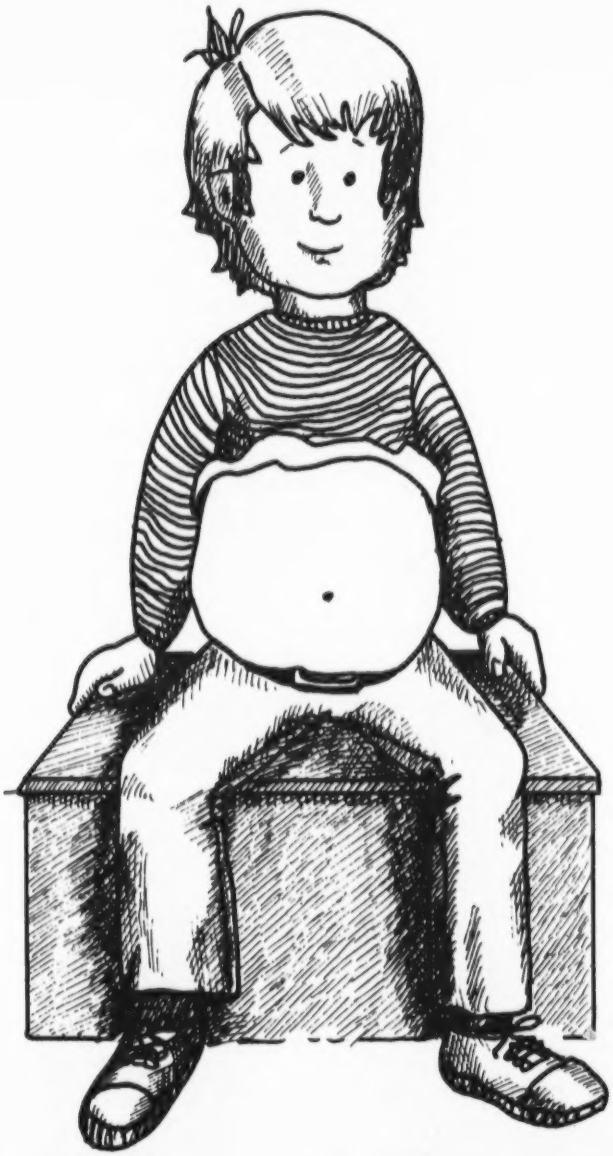


Circle B



LICOL'S TRUE COLORS

After playing Shadow Tag, Licol goes to his favorite class, science. It is in science that Licol learns more about his true self and makeup. Help Licol show his true colors by using a special technique called chromatography which separates a single color into pigments. Cut out and glue a small piece of blotter paper, filter paper or white paper toweling to Licol's belly below. Put a drop of food coloring or a spot of color from a water soluble felt tipped pen on Licol's belly. Observe the drop and colors. On the color chart below, list the pigments seen on Licol. NOTE: If your color does not separate, it may be one of a pure dye with just one color. Try other colors. On the other side of this page, make a list of happy colors, sad colors, quiet colors, loud colors, fast colors and slow colors and what they may mean. Hopefully you will have a **red**-letter day when you do this because more than once in a **blue** moon things will go right for you and Licol.



COLOR CHART

Name of color: _____

Pigments seen:

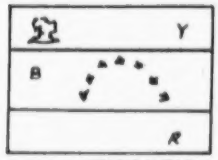
_____

_____

_____

_____

_____

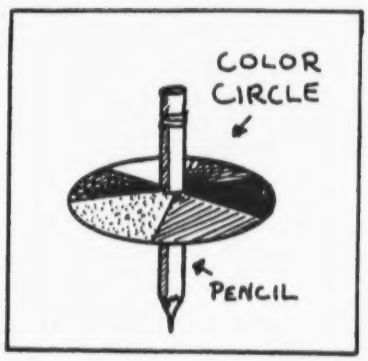


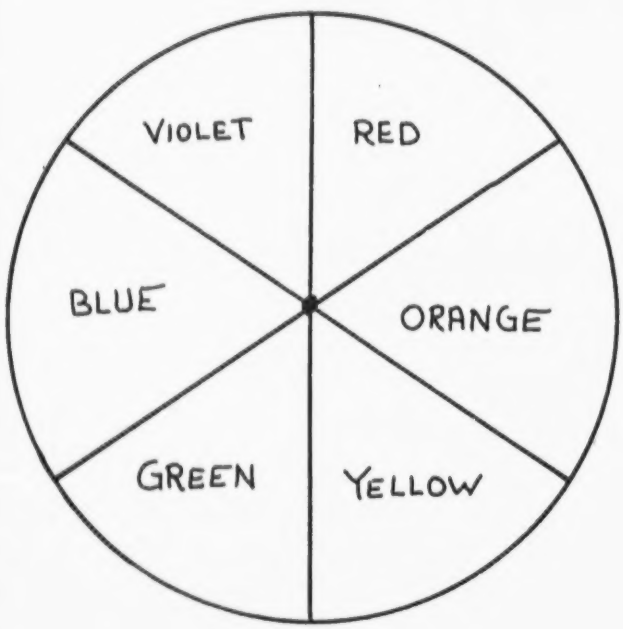
VENEZUELA

LICOL GETS IT TOGETHER

In science class, Licol learns his true makeup when he separates himself into different colors. He thinks about what these colors may mean to him. In this experiment, help Licol spin himself back together again. Licol will then understand that he is made up of white light which is a mixture of **all colors**. Thus, the name LICOL. Color the colors in the circle below. Cut out the circle and mount on cardboard. Push a sharp pencil through the center of the circle. Spin the pencil like a top or rub it back and forth between your hands. Answer these questions.

1. What two letters in the name "Licol" are shown below when the circle spins? ____ ____
2. What three letters in the name "Licol" are shown when the circle is not spinning? ____ ____ ____
3. What two words were used to make Licol's name? a)_____ b)_____
4. What are the three primary colors shown in the flag above? a)_____ b)_____ c)_____
5. Each star in the flag above stands for one of seven basic colors that make up Licol. What are these seven colors? Hint: ROY G. BIV a)_____ b)_____ c)_____ d)_____ e)_____ f)_____ g)_____

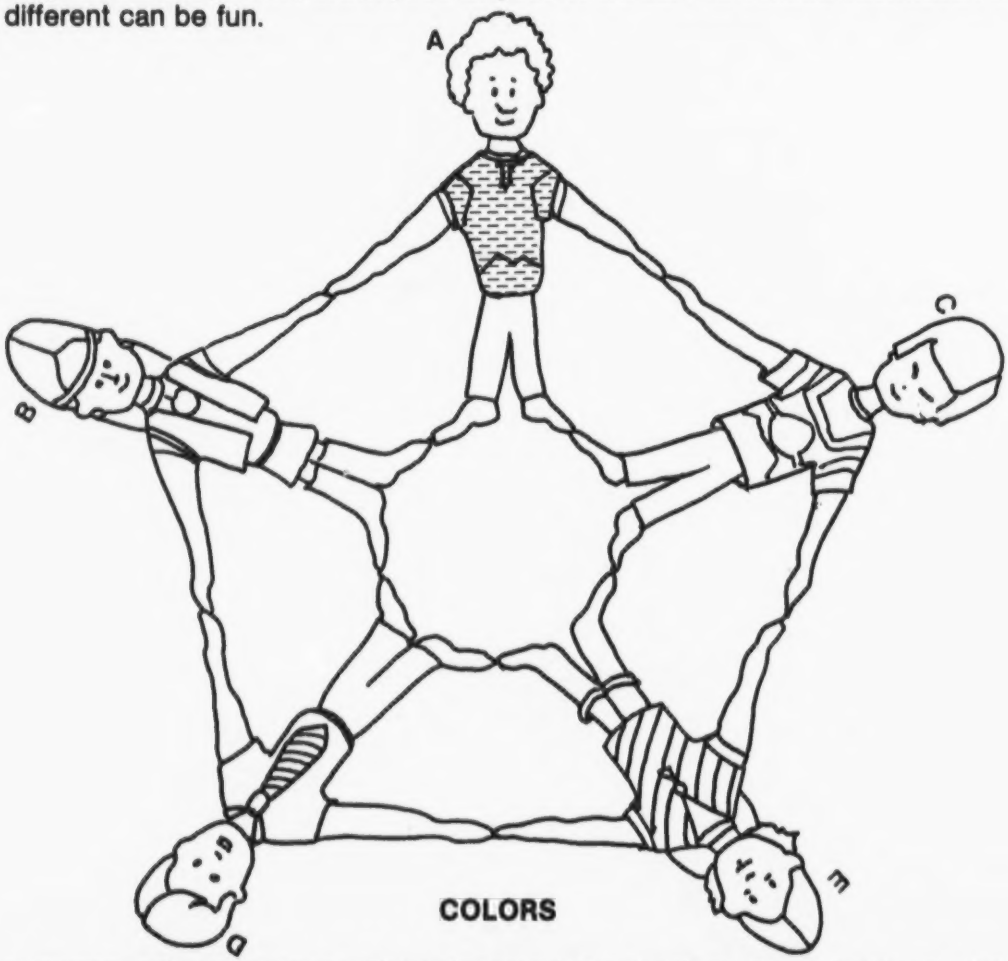




UNITED NATIONS

MANY PEOPLE: ONE RACE, HUMANITY

By doing experiments in science, Licol knows that he, like white light, is made up of all colors. Because of this, he is able to study, learn about and understand others. In social studies class, Licol observes that there are many different colored people in the world; but, like himself, they all seem to be one when they work together. Below are only five of many such people. Color the person from Africa black, the Native North American red, the person from Asia yellow, the person from Central America brown and the person from Europe white. Find out what makes people different but still alike by reading the story below. Then on the back of this page, write a story about what it would be like if everything were black, white, brown, red or yellow. Be sure to include information on how being different can be fun.



COLORS

The townspeople were angry. They disagreed about colors. Some believed white was best. Others believed in black. Many preferred brown, red or yellow. It was a troubled place.

A judge came to rule on an official town color. He brought a great big box and left it open in the town square. It was filled with five different colors of shoe polish.

The townspeople took all the polish. After all, the five colors were there and they were **free**.

Each person polished his/her own shoes. When the day arrived to decide on an official color, no one appeared in court.

Everybody was home enjoying their beautiful shoes.

Story by Ben Bluitt

LET THERE BE PEACE ON EARTH*

(Let It Begin With Me)

By
SY MILLER and
JILL JACKSON

Let there be peace on earth And let it be - gin with me; Let there be peace on earth, The peace that was meant to be. With God as our Fa - ther, Broth - ers all are we.
Let me walk with my broth - er In per - fect har - mo - ny. Let peace be - gin with me, Let this be the mo - ment now. With ev - 'ry step I take, Let this be my sol - emn vow: To take each mo - ment and live each mo - ment In peace e - ter - nal - ly. Let there be peace on earth And let it be - gin with me.
Let it be - gin with me.

FOLLOW A RAY OF LIGHT TO PEACE ON EARTH

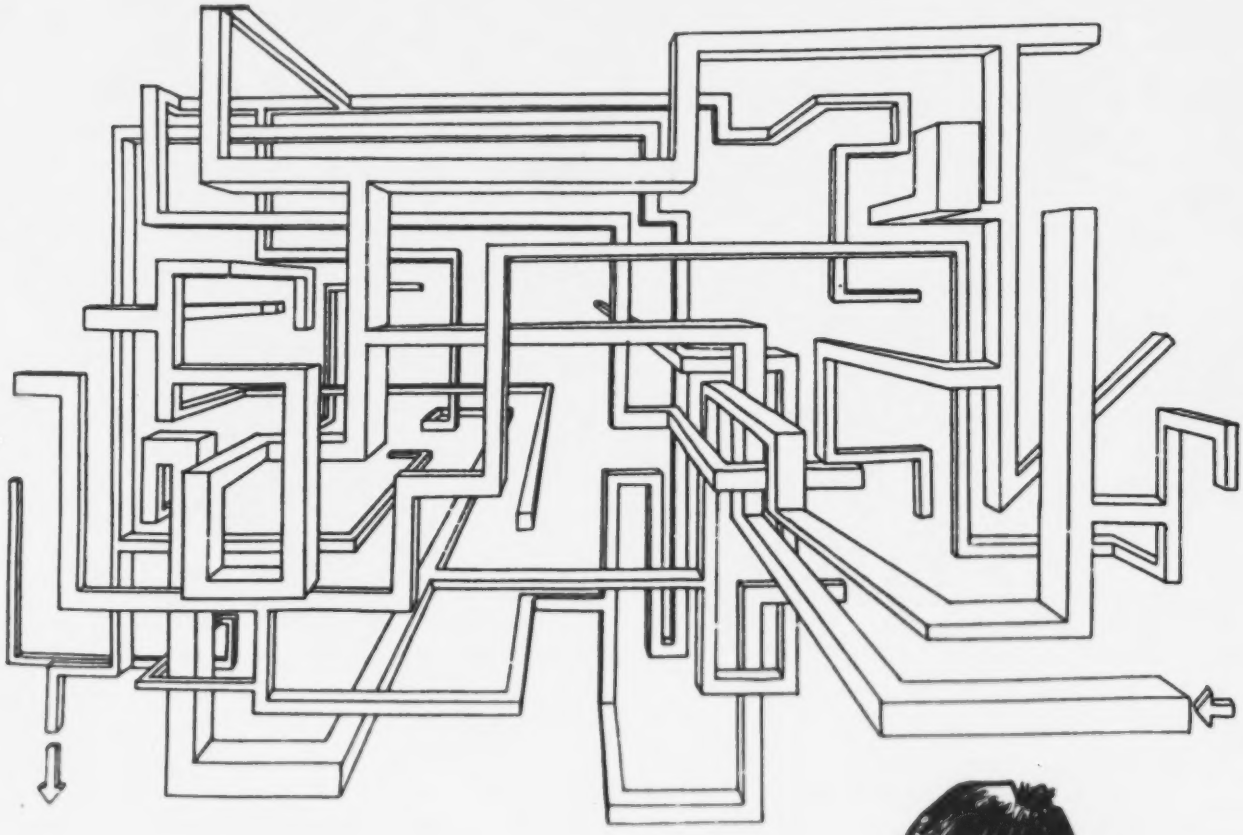
Licol now understands that there are different types of people on Earth, but when put together they all seem to be one. In music class, Licol plans to sing this song. Before he begins, he thinks about how reflected light helps him see people of different colors. He also knows that reflected light helps him read the notes and words in the song. With help from your teacher, read the notes and music. Sing the song. Quietly think about this experience. Then design a sticker or poster that advertises world peace. Share your works with others at school, home and in your community.

1986: The International Year of Peace

*The author wishes to thank Jill Jackson for permission to use this song in this book.

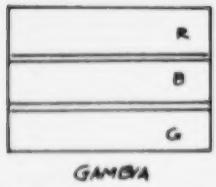
THE ART OF LIGHT IN THE THIRD DIMENSION

After a peaceful activity in music, Licol goes to art class where the class works on perspective, the art of drawing something on a flat surface so it looks like it's in three dimensions. Below is a light perspective drawing made by a sixth grade youngster.* With a pencil, trace the path of light through the 3-D maze. Next color the path. In an encyclopedia, look up the word *holography*. Tell your classmates what it means and how holography is used in our lives. Then make a drawing of a hologram in the space below.



MY HOLOGRAM

*Steve Dick, Bedford Schools, Temperance, Michigan

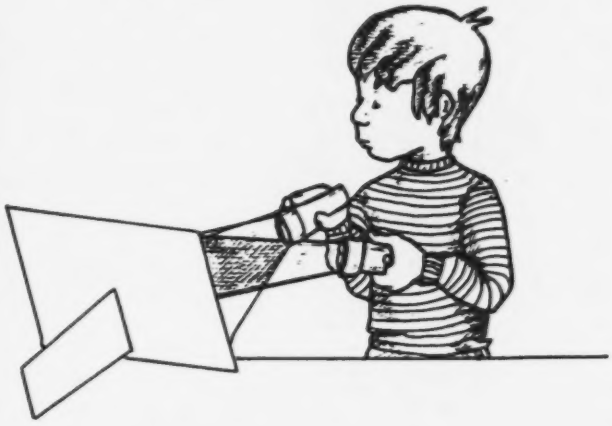


GAMBA

THE ART OF MIXING COLORS

After Licol makes a 3-D drawing, he continues his study of art by mixing pigments found in various paints. Help Licol do this activity. Tape or glue this page to a sheet of cardboard. Slide cardboard and sheet into a clear plastic bag. In the boxes below, mix a variety of three primary pigment colors of paints: **red**, **blue** and **yellow**. Fill in the blank with the name of the new color made by mixing these colors. Remove sheet from plastic bag. Allow paints to dry on plastic bag. Attach to window. Gather information on making stained-glass objects.

A	BLUE and RED	**B**	RED and YELLOW	**C**	BLUE and YELLOW	**D**	BLUE, RED and YELLOW
New Color _____		New Color _____		New Color _____		New Color _____	



Unlike the three primary pigment colors for paint, **red**, **blue** and **yellow**, the three primary colors of light are **blue**, **red** and **green**. Wrap a variety of blue, red and green cellophane paper over the ends of each of three flashlights. Mix the colors of light as shown. In the blank, write the name of the new color made after mixing light.

E	RED and GREEN	**F**	BLUE and GREEN	**G**	RED and BLUE	**H**	RED, GREEN and BLUE
New Color _____		New Color _____		New Color _____		New Color _____	

You can learn more about mixing colors by visiting a paint store. Ask for a color chart. Observe how various colored paints are mixed together to make a new color. Make a display board of paints and show it to your class.

LIGHT AND COLOR: FROM MINORS TO MAJORS

Licol now goes to physical education class where he plays various sports. While playing, Licol observes many colors around him. Help Licol by coloring in your school colors on the cheerleader and player below. With help from your physical education teacher, color the major league baseball hats the correct colors. Then talk to an athlete. Find out why athletes sometimes wear **eye black**, a dark material worn on their cheeks under the eyes. What does **eye black** do to light? Complete your study by making a list of sounds heard at a sports event. The crack of the bat may be one such sound, your favorite cheer another.

A

B

C

D

E

F

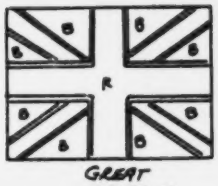
G

H

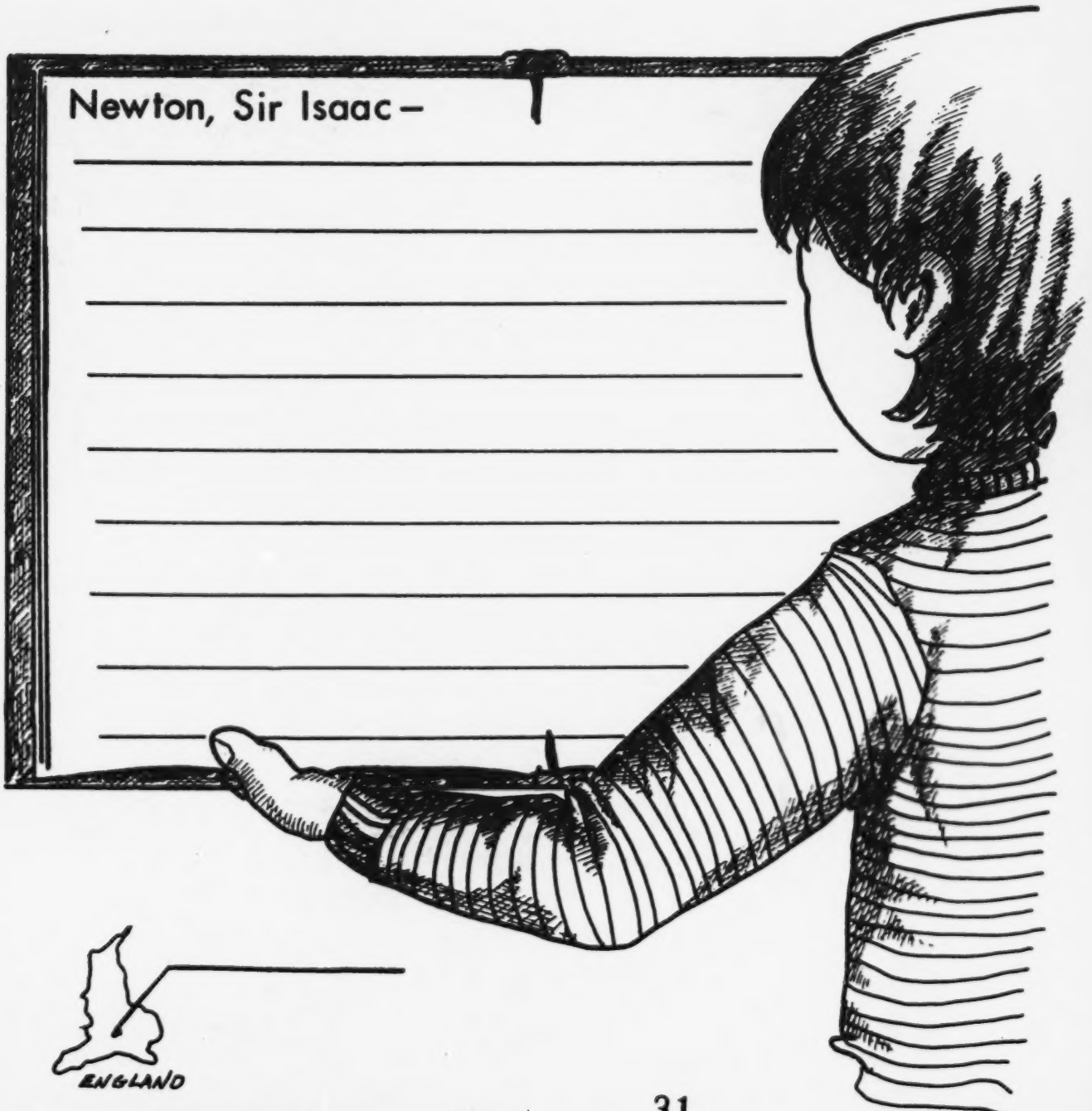
I

J

LIBRARY STUDY



After physical education class, Licol goes to the library to learn more about light and color. Help Licol further his study by locating an encyclopedia. Look up the name Sir Isaac Newton. On the encyclopedia below, write a story about Newton's discovery of light being made up of colors. On the map of England below, print the name of the city in England where the BODLEIAN LIBRARY is located. This library contains many records of Newton's work on light and color.

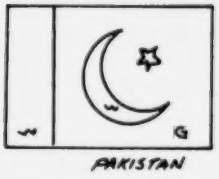


REFLECTIONS

The school day ends for Licol after library time. He collects his things, boards the bus and returns home. After time for play and dinner, Licol reflects on the day's activities. Help Licol keep a record of the activities by coloring the star as you complete each one. Then have your teacher and parents initial each completed activity.

★	Page	Teacher	Parents
☆	2 Young Scientists Explore The World of Light		
☆	3 Young Scientists Explore The World of Color		
☆	4 Good Morning Sun: Meet Licol		
☆	5 A Spoonful of Bends		
☆	6 Toothbrush Travels		
☆	7 Mirror Magic		
☆	8 Dress for School		
☆	9 Secret Message		
☆	10 Off to School		
☆	11 Licol Meets Colorful People in School		
☆	12 Licol Meets His Teacher		
☆	13 Licol Does an Eye Opener Activity		
☆	14 Pupil Power		
☆	15 Get the Angle		
☆	16 Reading Blindness		
☆	17 Reading Awareness		
☆	18 Spell Them RIght		
☆	19 Eye Corrections		
☆	20 Shadow Tag		
☆	21 Licol's True Colors		
☆	22 Licol Gets It Together		
☆	23 Many People: One Race, Humanity		
☆	24 Follow a Ray of Light to Peace on Earth		

★	Page	Teacher	Parents
☆	25 The Art of Light in the Third Dimension		
☆	26 The Art of Mixing Colors		
☆	27 Light and Color: From Minors to Majors		
☆	28 Library Study		
☆	29 Reflections		
☆	30 The Moon		
☆	31 The Stars		



THE MOON

After reflecting on the day's activities, Licol puts his pajamas on and slips into bed. He looks out the same window in which he saw the rising morning sun and now spots the evening moon. Licol knows that the moon does not make its own light but acts like a mirror and reflects light from the sun. Below are the eight phases of the moon. For each phase, color the part of the moon that is **not** lit up black, the part that is lit up yellow. Then find out when people first set foot on the moon. On the other side of the page, write a story that tells about your feelings if you were to land on the moon.

New Moon

Waxing Crescent

First Quarter

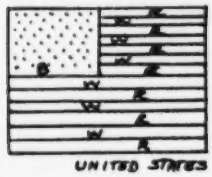
Waxing Gibbous

Full Moon

Waning Gibbous

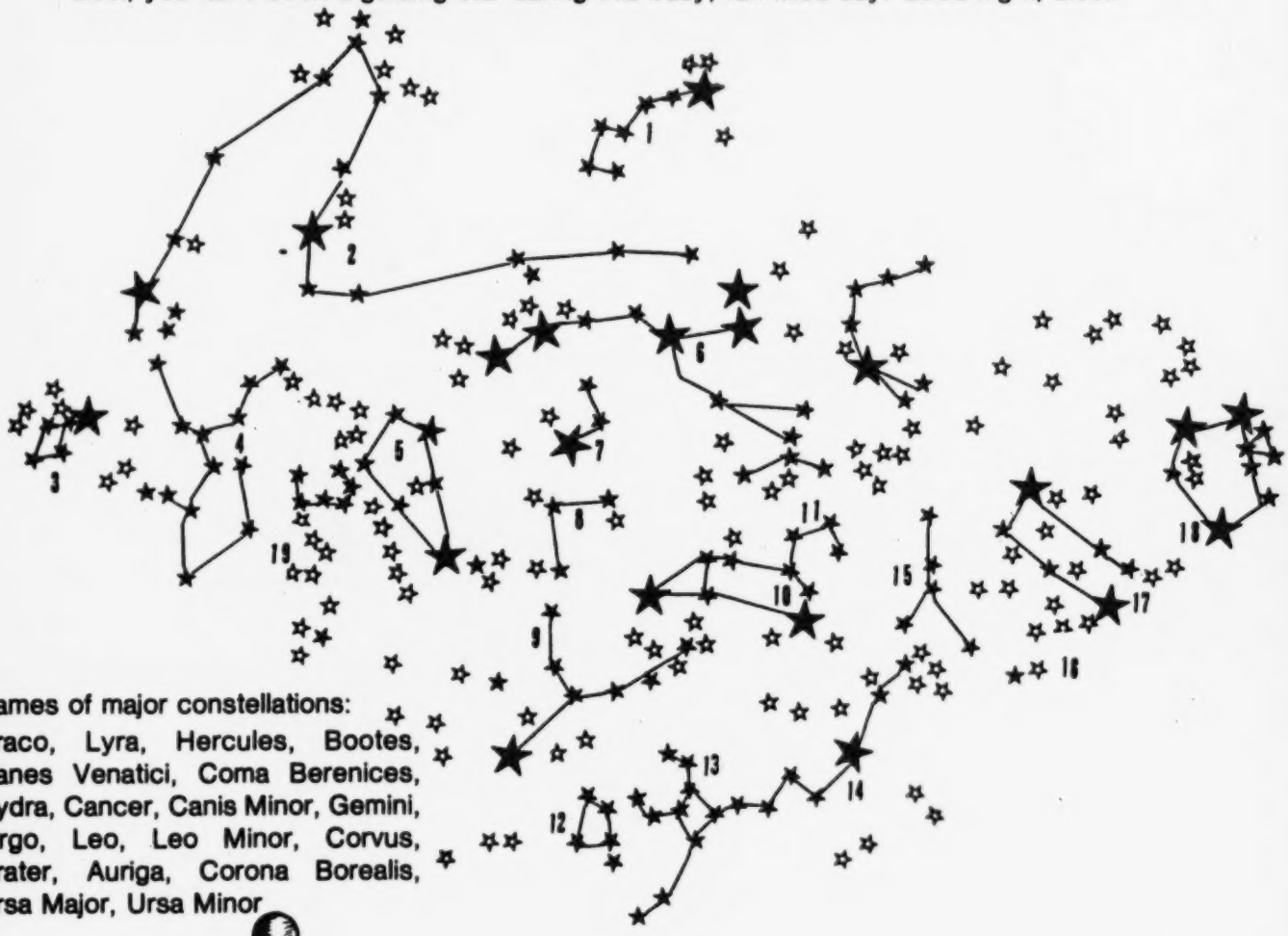
Last Quarter

Waning Crescent



THE STARS

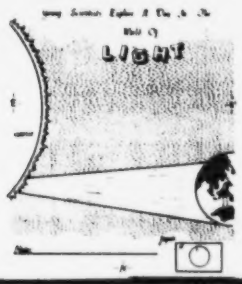
Shortly before Licol says "good night" to members of his family and falls asleep, he observes many stars in the sky. Using the words below, help Licol name the 19 constellations that he sees. With a light-colored pen, trace over the lines in each constellation to make each one more colorful. On the back of this page, write the number and the correct name for each constellation. Then list five of the brightest stars found in the sky. Licol, you have been a guiding star during this busy, fun-filled day. Good night, Licol.



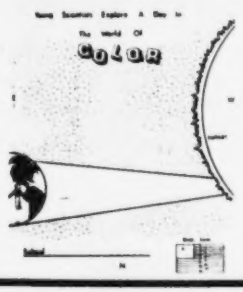
Names of major constellations:
Draco, Lyra, Hercules, Bootes, Canes Venatici, Coma Berenices, Hydra, Cancer, Canis Minor, Gemini, Virgo, Leo, Leo Minor, Corvus, Crater, Auriga, Corona Borealis, Ursa Major, Ursa Minor

ANSWERS AND POSSIBLE FLAG* RELATIONSHIPS

Page 2
(Front Cover—Student Book)



Page 3
(Back Cover—Student Book)



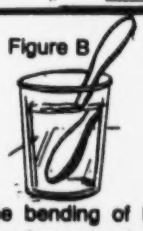
Page 4

ROY G. BIV =
Red, Orange, Yellow, Green, Blue, Indigo and Violet

*Sun on flag is related to sun in activity.

Page 5

Figure B



Refraction: The bending of light as it passes from one transparent substance into another one that has a different density.

*Peaks on flag similar to bent light waves.

Page 6

Cavity

*Circle on flag related to cavity in activity.

Page 7

Picture A	Picture B
1. Right	1. Left
2. Left	2. Right
3. Right	3. Left

Bonus: Left

*X on flag related to X or crossover of light waves in activity.

Page 8

White clothes are worn in summer because white reflects sunlight. The ice cube should keep the longest on white paper, followed by yellow, dark blue and black.
Clothing marked K, H, I are correct clothes.

*Colors on flag related to colors of clothes in activity.

Page 9

Message should read:
Dear Licol,
We love you and are proud of you. We hope you have a great day in school.
Love, Mom and Dad

*Figures on flag could be related to a code.

Page 10

Total distance Routes A and B: 7, 10 inches (17, 25 cm), respectively.
Mileage: 14, 20 miles, (22, 32 km.)

Object	Object Color
1. stoplight/red, yellow, green	
2. stop sign/red	
3. yield sign/yellow	
4. sun/orange, yellow	
5. water in stream/blue	

*Bell on flag is related to a school bell.

Page 11

Answers will vary.

*Symbol and colors on flag could be related to colors found in school and yin-yang philosophy of life.

Page 12

Red, white and blue flag.
Pledge of Allegiance written by Francis Bellamy

*Sun on flag could symbolize both a warm teacher and classroom atmosphere.

Page 13

1. B, 2. A, 3. D, 4. C, 5. E, 6. F.

*Sun coming up over the horizon is related to "eye opening up" in eye opener activity.

Page 14

The iris controls the size of the pupil which is smaller in normal light, larger in the dark.

*The white circle on the flag could be related to pupil size in different environments.

Page 15

Figure A
Large angle of incidence: 73°
Large angle of reflection: 70°
Figure B
Small angle of incidence: 20°
Small angle of reflection: 22°
Acute angle = less than 90°
Obtuse angle = greater than 90° but less than 180°

*Shapes on flag similar to angles in activity.

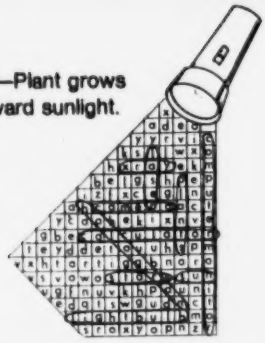
Page 16

Answers will vary.

*Black star of flag could represent a blind spot.

Page 17

Figure C—Plant grows toward sunlight.



*Leaf on flag related to leaf on a plant.

Page 18

1. Silhouette, 4. Illusion, 8. Angle, 12. Mirror, 15. Symmetry, 16. Incidence

A = won't light
B = will light
C = won't light

*Symbols on flag related to symmetry of shadows from light bulb.

Page 19

Figure A—concave, Figure B—convex, Figure C—concave, Figure D—convex

Todd's vision is corrected with a concave lens, Jenny's with a convex lens.

*Black triangle on map is related to light waves being focused on retina in eye.

Page 20

Soccer (A)	Basketball (E)
Hockey (B)	Swimming (F)
Gymnastics (C)	Archery (G)
Track (D)	Tennis (H)

Shadows shorter at noon, longer in early a.m. and late p.m.

*Right half flag = sunlight; left half= shadow

Page 21

Answers will vary.

*Flag represents a nearly complete color spectrum.

Page 22

1. LI, 2. COL, 3. light and color, 4. blue, red, yellow 5. red, orange, yellow, green, blue, indigo, viloet

*Seven stars on flag represent seven colors of spectrum. Three bands on flag represent three primary pigment colors.

Page 23

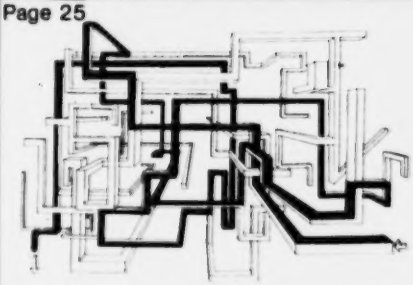
A. black, B. red, C. yellow, D. white, E. brown

*United Nations flag represents unity of all nations.

Page 24

*Peace dove flag is a symbol of world peace.

Page 25



*Triangles in flag represent perspective in activity.

Page 26

A. purple, B. orange, C. green, D. brown-black, E. yellow, F. cyan (blue-green), G. magenta, H. white

*Blue, red and green on the flag represent three primary light colors.

Page 27

A. Blue (Kansas City), B. Blue (Boston), C. Red (Cincinnati), D. Blue (Los Angeles), E. Green & yellow (Oakland), F. Blue (New York),G. Black (San Francisco), H. Red (St. Louis), I. Blue (Detroit), J. Orange (Houston). Eye black eliminates glare of light.

*Design on flag can represent pennants used in athletics.

Page 28

Oxford

*Flag represents Great Britain, Newton's native country.

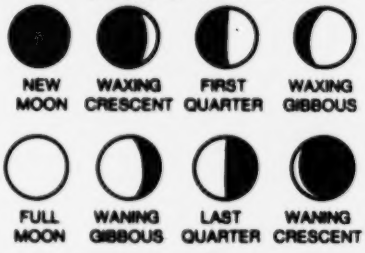
Page 29

Record of activities done in book.

*Yellow star on flag can represent completed activity colored in by youngsters.

Page 30

Phases of the moon:



*Flag represents moon and stars in sky.

Page 31

1. Ursa Minor	11. Leo Minor
2. Draco	12. Corvus
3. Lyra	13. Crater
4. Hercules	14. Hydra
5. Bootes	15. Cancer
6. Ursa Major	16. Canis Minor
7. Canes Venatici	17. Gemini
8. Coma Berenices	18. Auriga
9. Virgo	19. Corona Borealis
10. Leo	

*Flag features stars and stripes made by light and color.